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ESTIMATES OF (CO) VARIANCE COMPONENTS FOR DIRECT AND MATERNAL EFFECTS ON BIRTH WEIGHT OF EGYPTIAN BARKI LAMBS

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ABSTRACT

The present study was undertaken to estimate (co) variance components for birth weight (BW) of Barki lamb's. The models fitted included direct genetic, maternal genetic and direct-maternal genetic co-variance and maternal permanent environmental effects using six forms of animal models (MTDFREML). Data and pedigree information of the studied Barki sheep were collected from 1994 to 2001. A direct heritability estimate of 0.12 and maternal heritability estimate of 0.21 were obtained for BW. Maternal permanent environmental effect was found to be 0.092 with little contribution on BW. The estimate of the direct- maternal correlation was high and positive. Results indicated that the inclusion of maternal effects in genetic evaluation of early growth traits in Barki lambs were significant and need to be considered in any selection program to improve Barki sheep.

INTRODUCTION

Barki sheep dominated the north western desert of Egypt since it is known to be well adapted to the harsh desert conditions and scarce vegetation (El-Wakil *et al.,* 2008). Birth weight is of potential economic importance through its effect on the livability and pre-weaning growth of the lamb and hence the quantity of meat produced from the adult animal. An intermediate optimum has been shown for birth weight with excessively large lambs are liable to dystocia while extremely small lambs are often at risk of death from various diseases (Al-Shorepy, 2001).Many factors were reported to affect the birth weight of lambs. Among these factors, direct genetic effects, maternal genetic effects and environmental factors which affect both the lamb and its dam. Thus, to achieve the optimum genetic progress in a selection program both direct and maternal components should be taken into account (Meyer, 1992 and Maria *et al.,* 1993).

In mammalian species, maternal effects involve an impact of the mother on her offspring other than that through the genes she transmits to them in addition to the mother's ability to produce sufficient milk to support the growth of her lambs as well as her general maternal behavior (Bradford, 1972).Consequently, the dam contributes to the phenotypic value of her offspring, not only by a sample half of her genes but also through her genes responsible for maternal traits. Fortunately, modern statistical methods for variance component estimation allow partitioning of the genetic variance into direct and maternal variances for genetic evaluation (Mrode, 1996).Therefore, the presents study employed these statistical methods to estimate genetic parameters for direct and maternal genetic and environmental effects of birth weight in order to help in planning for a breeding program to improve Barki sheep.

MATERIALS AND METHODS

Data of this study and its corresponding pedigree were obtained from the records of the Barki sheep flock from 1994 to 2001 available at the Desert Research Center of Egypt. During such period, animals raised at the Barki sheep flock in Maryout Research Station, 35 km west of Alexandria. Ewes were often first mated at approximately 16 months of age. Mating groups of 20-25 ewes with one ram were assigned during the mating season. At birth, lambs were ear-tagged, and kept with their mother's to suckle and weighed within 24 hours after birth. Detailed feeding and flock management was described elsewhere (El-Wakil et al.,2009).Birth weight records of 1176 lambs, progenies of 83 siresand690 ewes, were used for the statistical analysis to estimate the studied genetic parameters. The characteristics of the data structure for birth weight are shown in table (1).

Table 1. Characteristics of the data structure for birth weight.

Number of lambs	1176
Number of sires	83
Number of dams	690
Average of progeny for each sire	14.7
Average of progeny for each dam	1.7
Mean forBW(kg)	3.56
Standard deviation (SD**)**	0.70
Coefficient of variation (CV %)	19.86

Statistical analysis

To identify the fixed effects included in the model, the GLM procedure of SAS (2002) was performed on sex, year of birth and age of dam. These effects were found to be significant for BW and were included in the model. Six different animal models were fitted, differentiated by including or excluding maternal effects, with and without covariance between maternal and direct genetic effects. The following six different animal models were employed to estimate genetic parameters:

Where, y is a vector of birth weight observation, b, a, m, c and e are vectors of fixed effects, direct additive genetic effects, maternal additive genetic effects, maternal permanent environmental effects and the residual effects, respectively. X,Z_1, Z_2 and Z_3 are corresponding design matrices associating the fixed effects, direct additive genetic effects, maternal additive genetic effects and maternal permanent environmental effects to vector of y, σ_{am} is the additive direct and maternal genetic, A is the additive numerator of the relationship matrix. The genetic correlation between direct and maternal genetic effects, direct heritability (h^2_d) and maternal heritability (h^2_m) were calculated from (co) variance components. The computations were performed by MTDFREML software (Boldman *et al.,* 1995), which is based on the general concept of the restricted maximum likelihood algorithm. The value of 10^{-9} was used as the convergence criterion in all analysis.

RESULTS AND DISCUSSION

Mean, standard deviation and coefficients of variation of Barki lambs for birth weight (BW) are presented in Table 1. The mean value in the present study was 3.56 kg. The obtained results were similar to those reported elsewhere for Barki sheep in the same flock (Bedier *et al.,* 1995; El-Wakil *et al.,* 2009).On Mehraban lambs, Gamasaee et al*.* (2010) recorded a mean value of 3.38 kg lower than that obtained in this study for BW, while Mokhtari et al*.*(2012) recorded a mean value of 4.5 kg for BW in Arman lambs. Different estimates reported for average BW probably due to breed differences as well as the feeding and management conditions under which the flock was maintained.

Estimates of (co)variance components and genetic parameters for BW in single-trait analysis fitting six models are presented in Table 2. Model 1, which ignored maternal effects, resulted in large estimates for direct additive variance (σ^2_a) and direct heritability (h^2_d) compared with other models. In Model 2 to Model 6, the addition of the maternal environmental effect and maternal genetic effect increased the log likelihood values significantly and reduced the estimates of both σ^2_a and h^2_d compared with Model 1. Meyer (1992) showed that models not accounting for maternal genetic effects could result in substantially higher estimates of additive direct genetic variance and, therefore, higher estimates of h^2_d.If maternal effects are present, the estimate of additive genetic variance will include at least part of the maternal variance. Therefore, estimates of direct heritability will decrease when maternal effects are included. Model 3, which included an additive maternal effect, yielded smaller estimates of $\sigma^2_a$and h^2_d than did Model 1. The additive maternal genetic effect was determined to be more important than the permanent maternal environmental influence of the dam for this trait in Barki sheep.

Estimates of maternal heritability for BW were usually large than those estimates of direct heritability (Table 2). This suggests that maternal effects need to be considered in selection for growth in Barki sheep. Maternal effects expressed during gestation and lactation has been expected to have a diminishing influence on weight as lambs became older. Estimates of maternal heritability obtained for BW in Barki sheep seemed to be higher than those values reported by some authors (Gamasaee *et al.,* 2010; Lotfi *et al.,* 2010; Mohammedi *et al.,* 2010) and less than those reported by other authors (Tosh and Kemp, 1994; Bahrein *et al.,* 2007; Mehmet and Serdar, 2009) for several breeds of sheep.

Table 2: Estimation of variance components and heritability for birth weight (BW).

Model	σ^2_a	σ^2_m	σ^2_c	σ_{am}	σ^2_e	σ^2_p	h^2_d	h^2_m	c^2	-2 log L
1	0.146	-	-	-	0.296	0.443	0.33±0.085	-	-	226.392
2	0.052	-	0.092	-	0.290	0.434	0.12±0.061	-	0.21	205.687
3	0.051	0.092	-	-	0.292	0.434	0.12±0.061	0.21±0.045	-	205.792
4	0.046	0.047	-	0.046	0.294	0.434	0.11±0.058	0.11±0.129	-	205.040
5	0.051	0.092	0.0	-	0.292	0.434	0.12±0.060	0.21±0.225	0.13	205.792
6	0.046	0.047	0.0	0.047	0.293	0.434	0.11±0.059	0.11±0.303	0.16	205.040

σ^2_a=Direct additive variance., σ^2_m =maternal additive variance.,σ^2_c= permanent environmental variance., σ_{am} = direct maternal covariance, σ^2_e = residual variance., σ^2_p =total phenotypic variance., h^2_d = direct heritability, h^2_m = maternal heritability,c^2 = ratio of permanent environmental variance to total variance.

Estimate of the fraction of variance due to maternal permanent environmental effect (c^2) was ranged from 0.16 to 0.21 for BW trait (Table 2). This result showed that permanent environmental effects of the dam lowest influence on birth weight and lambs are more dependent on their own genetic potential for growth, and lambs are more dependent on their own genetic potential for growth. The negligible estimate of c^2also suggests that maternal effects were primarily due to maternal additive genetic effects. Tosh and Kemp (1994) estimated c^2 for BW in Hampshire, Polled Dorset and Romanov lambs as 0.37, 0.27 and 0.32, respectively. Mousa et al*.* (1999), reported c^2 estimate of 0.09 for a composite terminal sire breed. The permanent environmental effect of the dam on birth weight is mainly determined by uterine capacity, feeding level at late gestation, and the maternal behavior of dam (Snyman *et al.,* 1995).

The covariance between the direct and maternal genetic effect (σ_{am}) estimate was positive and of 0.046 for BW Table 2. The covariance between the direct and maternal genetic effect (σ_{am}) estimated by Tosh and Kemp (1994), for Hampshire, Polled Dorset, and Romanov lambs were negative and ranged from -0.13 to -0.56, while, Maria et al. (1993) reported higher negative estimates which they attributed to the small number and the structure of the data. However, Mehmet and Serdar (2008) found that with Merino lambs the covariance between direct and maternal genetic effects was ranged from -0.061to -0.028.

Conclusion

Both direct and maternal effects should be considered to enhance the accuracy of genetic parameters obtained and hence the precision of genetic evaluation. Results obtained might help in planning appropriate breeding programs to improve growth performance of the Barki sheep.

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تقدير مكونات التباين والتغاير للتأثير المباشر والأمى على وزن الميلاد فى حملان البرقى المصرية

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أجريت هذه الدراسة لتقدير مكونات التباين و التغاير لوزن الميلاد فى حملان البرقى باستخدام ستة نماذج من نموذج الحيوان تشتمل على التأثير الوارثي المباشر والتأثير الوراثى الأمى والتغاير بين التأثيرات الوراثية المباشرة والأمية بالإضافة إلى التاثيرات الأمية البيئية الدائمة. وقد أجريت الدراسة باستخدام سجلات وزن الميلاد وسجلات النسب لقطيع الأغنام البرقى التابعة لمركز بحوث الصحراء منذ عام ١٩٩٤ حتى عام ٢٠٠١. أوضحت النتائج المتحصل عليها لوزن الميلاد أن المكافئ الوراثي المباشر كان ٠,١٢ والمكافئ الوراثى الأمي كان ٠,٢١ بينما قدر التأثير الأمى البييء الدائم بمقدار ٠,٠٩٢ وكانت تقديرات الارتباطات الوراثية بين التأثيرات المباشرة والأمية عالية وموجبة، كما أشارت النتائج إلى أهمية ان يتضمن التاثير الأمى فى التقيم الوراثى لصفات النمو فى عمر مبكر فى الحملان البرقى وأن يكون موضع اعتبار فى برامج التحسين الوراثى للأغنام البرقى .

قام بتحكيم البحث

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